ORIGINAL

Squire, Sanders & Dempsey
L.L.P.
Counsellors at Law
1201 Pennsylvania Avenue, N.W.
P.O. Box 407
Washington, D.C. 20044-0407

Telephone (202) 626-6600
Cable Squire DC
Telecopier (202) 626-6780

Direct Dial Number
(202) 626-6722
bbartolome@ssd.com

January 24, 2000

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VIA COURIER

Magalie Roman Salas, Secretary
Office of the Secretary – TW A306
Federal Communications Commission
445 Twelfth Street, S.W.
Washington, D.C. 20554

RE: ***In the Matter of Digital Audio Broadcasting Systems And Their Impact On the Terrestrial Radio Broadcast Service*, MM Docket No. 99-325**

Dear Ms. Salas:

On behalf of the Consumer Electronics Association ("CEA"), I am submitting an original and eleven copies of CEA's Comments in the above-captioned proceeding. Pursuant to filing instructions in paragarph 61 of the Notice of Proposed Rule Making in MM Docket No. 99-325, a diskette and paper copy of CEA's filing has also been hand delivered, on January 24, 2000, directly to William J. Scher with the Office of Engineering & Technology and to the International Transcription Service.

Please contact the undersigned if you should have any questions about this filing.

Very truly yours,

B. Bartolome

Benigno E. Bartolome

Counsel for the
Consumer Electronics Association

Enclosures

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ORIGINAL

Before the
FEDERAL COMMUNICATIONS COMMISSION
Washington, D.C. 20554

In the Matter of	)	
	)	
Digital Audio Broadcasting Systems	)	MM Docket No. 99-325
And Their Impact On the Terrestrial	)	
Radio Broadcast Service	)	

To: The Commission

COMMENTS OF THE CONSUMER ELECTRONICS ASSOCIATION

Of Counsel:
David A. Nall
Benigno E. Bartolome
Squire, Sanders & Dempsey L.L.P.
1201 Pennsylvania Avenue, N.W.
Post Office Box 407
Washington, D.C. 20044
(202) 626-6600

Michael Petricone
Vice President,
Technology Policy

Gary S. Klein
Vice President,
Government and Legal Affairs

Ralph Justus
Vice President,
Technology and Standards

2500 Wilson Boulevard
Arlington, Virginia 22201
(703) 907-7600

January 24, 2000

SUMMARY

The Consumer Electronics Association ("CEA") supports the Commission's efforts to introduce digital audio broadcasting ("DAB") to the American public. CEA believes that DAB is poised to revolutionize radio broadcast service in the same way that digital television is revolutionizing the broadcast of television services. It is clear from CEA's own market research that consumers desire improved service and enhanced audio quality. The challenge facing the Commission in this proceeding, however, is to select the best available DAB system – *i.e.*, a system that does not interfere with existing radio reception, will work in home and mobile environments, and will produce the "CD-quality" sound that consumers have come to expect and enjoy.

CEA has no vested interest in any particular in-band, on-channel ("IBOC") DAB system; rather, CEA's interest is to provide information to the Commission that, hopefully, will prove useful in evaluating not only the technical viability and demanding performance objectives of an IBOC proposal, but also other concepts that enhance terrestrial DAB service, which includes the possible allocation of new spectrum for this service. CEA largely agrees with the appropriateness of the Commission's proposal for a tentative selection criteria for a DAB system. In this regard, CEA notes that while IBOC systems are intended to allow the simultaneous broadcast of analog and digital signals in the AM and FM bands without disruption of existing analog service, an IBOC DAB must also be able to demonstrate a superior radio service on its own merits in the "hybrid" mode alone before transitioning to an "all-digital mode," in order to establish its commercial viability from the time it is initially made available to the public. Additionally, although IBOC DAB presents many attractive attributes, IBOC proponents must

convincingly demonstrate that an IBOC-delivered audio experience is attractive to listeners, sufficient to persuade consumers to purchase new radio receivers.

Because IBOC DAB also is technically challenged (*e.g.*, limited in RF bandwidth which necessitates tradeoffs affecting audio quality, compatibility, and robust coverage), CEA strongly supports the Commission's efforts to consider the possibility of using new spectrum for terrestrial DAB services. It appears that the new-spectrum approach holds the most promise to meet listener expectations for terrestrial DAB with high-quality audio, robust coverage, and affordability.

CEA also urges the Commission to adopt a single DAB standard. Technical standardization is critical because the choice of one standard over another can have a major impact on the development of the DAB industry. A single standard provides certainty to consumers, licensees, and equipment manufacturers, especially during the launch of this new technology. Additionally, CEA believes that competent laboratory and field tests are critically needed to assess the full performance potential, and the interference impact, of DAB systems. Accordingly, CEA welcomes the opportunity to assist the Commission in its evaluation of the technical viability and quality of currently available IBOC system designs, as well as the trade-offs that an IBOC system might require.

TABLE OF CONTENTS

Before the
FEDERAL COMMUNICATIONS COMMISSION
Washington, D.C. 20554

In the Matter of	)	
	)	
Digital Audio Broadcasting Systems	)	MM Docket No. 99-325
And Their Impact On the Terrestrial	)	
Radio Broadcast Service	)	

To: The Commission

COMMENTS OF THE CONSUMER ELECTRONICS ASSOCIATION

The Consumer Electronics Association ("CEA"),[1] pursuant to Section 1.415 of the Commission's Rules, 47 C.F.R. § 1.415, hereby respectfully submits its comments in response to the above-captioned Notice of Proposed Rule Making ("NPRM").[2] In the NPRM, the Commission considers alternative approaches to introduce Digital Audio Broadcasting ("DAB") to the American public. The Commission invites comments to assist it in determining whether an in-band, on-channel ("IBOC") model or a model utilizing new spectrum would be the best means to introduce DAB service. Specifically, the Commission, by its NPRM: (1) reaffirms its commitment to provide radio broadcasters with the opportunity to take advantage of DAB

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1 The Consumer Electronics Association was formerly known as the Consumer Electronics Manufacturers Association ("CEMA"). Previous comments, letters, and other submissions concerning this proceeding were filed under CEA's previous name.

2 *See In the Matter of Digital Audio Broadcasting Systems And Their Impact On the Terrestrial Radio Broadcast Service*, MM Docket No. 99-325, Notice of Proposed Rule Making, FCC 99-325 (Nov. 1, 1999) ("*NPRM*"), 64 Fed. Reg. 216 (Nov. 9, 1999). The *NPRM* was in response to USA Digital Radio's ("USADR") petition for rulemaking, which requested initiation of a proceeding to implement IBOC DAB technology. *See* Petition for Rulemaking of USA Digital Radio Partners, L.P. (filed Oct. 7, 1998).

technology; (2) identifies Commission public policy objectives for the introduction of DAB service; (3) proposes criteria for the evaluation of DAB models and systems; (4) evaluates IBOC and new-spectrum DAB models; (5) inquires as to the need for a mandatory DAB transmission standard; and (6) considers certain DAB system testing, evaluation, and standard selection issues. CEA provides comments on each of these enumerated issues in turn. As a general matter, CEA supports the introduction of digital audio radio technology, but urges the Commission to ensure that any terrestrial DAB system selected has been sufficiently evaluated and tested so that it meets the public's listening expectations.

I. INTRODUCTION AND STATEMENT OF INTEREST

CEA, a sector of the Electronics Industries Alliance, is the principal trade association of the consumer electronics industry. CEA members design, manufacture, distribute, and sell a wide variety of consumer electronics equipment, including radio broadcast receivers. As such, CEA has an interest in maintaining the integrity of current radio products and, at the same time, in supporting efforts to open the electronics manufacturing industry to new product opportunities.

CEA has been an active participant in this proceeding and has maintained its support for the introduction of terrestrial digital radio service. In the instant proceeding, CEA filed comments and reply comments in response to USA Digital Radio Partners' ("USADR") petition for rulemaking, which requested initiation of a proceeding to implement IBOC DAB technology.

Additionally, CEA submitted various reports to the Commission to assist it in its evaluation of competing terrestrial DAB systems.[3]

As a general matter, CEA fully supports efforts to implement terrestrial digital audio radio systems. As CEA has stated in its previous filings in this proceeding, CEA has no vested interest in any particular IBOC DAB technology; rather, CEA's interest is to provide information to the Commission that, hopefully, will prove useful in evaluating not only the technical viability of IBOC DAB, but also other concepts that enhance terrestrial DAB service, which include the possible allocation of new spectrum for this service. Of critical importance is ensuring that the DAB system ultimately selected does not interfere with existing radio reception, will work in home and mobile environments, and will produce the "CD-quality" sound that consumers have come to expect and enjoy.

II. THE INTRODUCTION OF DIGITAL AUDIO BROADCASTING IS IN THE PUBLIC INTEREST.

CEA agrees with the Commission that fostering the development and implementation of terrestrial DAB is in the public interest.[4] As CEA pointed out in its comments in response to USADR's petition for rulemaking, alternatives to analog radio are becoming the preferred

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3 *See* Comments of the Consumer Electronics Manufacturers Association in RM-9395 (filed Dec. 23, 1998), at Appendix A ("CEMA Views on Performance Objectives & Analysis and Assessment of Technical Showings in USADR Petition for Rulemaking"), Appendix B ("Technical Evaluations of Digital Audio Radio Systems: Laboratory and Field Test Results; System Performance; Conclusions," Final Report (December 1997)) ("*Final Report*"). *See also* Joint Letter from the National Association of Broadcasters and the Consumer Electronics Manufacturers Association to Magalie Roman Salas, dated December 14, 1998, which included the following attachment: *National Radio Systems Committee, DAB Subcommittee, In-Band/On-Channel (IBOC) Digital Audio Broadcasting (DAB) System Test Guidelines, Part 1 – Laboratory Tests*, December 3, 1998 ("*NRSC Test Guidelines*").

4 *See NPRM* at ¶ 15.

method of listening to music, and CEA is optimistic that advances in digital audio radio technology might permit the creation of a terrestrial broadcast service to offer digital quality sound.[5] CEA believes that the implementation of DAB will provide improved radio broadcast services to consumers and will help promote the future viability of radio broadcasting in the United States.

While CEA is optimistic about the eventual introduction of terrestrial digital radio, it remains cautious about the successful deployment of an IBOC DAB system. As the Commission acknowledges in the NPRM, "IBOC DAB systems have not been conclusively proven to be technically viable at this point in time . . . ."[6] Further, CEA notes that its past evaluations of proposed IBOC DAB technologies revealed that their potential implementation would have caused an unacceptable degradation of the reception of "host" analog station signals as well as interference to other stations.[7] Further, due to the existing congested occupancy of the AM and FM bands, it was determined that analog-to-digital interference would severely limit potential IBOC DAB digital coverage. These deficiencies must be overcome if the new versions of IBOC DAB are to form the basis for providing terrestrial digital radio service in the United States. CEA thus welcomes the opportunity to assist the Commission in its evaluation of the technical viability and quality of currently available IBOC system designs, as well as the trade-offs that an IBOC system might require.

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5 *See* CEMA Comments in RM-9395 (filed Dec. 23, 1998), at 3-5.

6 *NPRM* at ¶ 2.

7 *See generally* CEMA Comments in RM-9395.

III. IBOC DAB MUST BE ABLE TO MEET ITS CHALLENGES AND DEMONSTRATE A SUPERIOR RADIO SERVICE ON ITS OWN MERITS IN THE "HYBRID" MODE ALONE IN ORDER TO ESTABLISH ITS COMMERCIAL VIABILITY.

The Commission raises many aspects of, and seeks comments on, matters relating to the "all-digital mode" of an IBOC transition.[8] IBOC systems are intended to allow the simultaneous broadcast of analog and digital signals in the AM and FM bands without disruption of existing analog service. A viable system, however, must minimize interference to analog AM and FM stations during that period when digital and analog service operate concurrently. As the Commission points out, the systems eventually may transition from a hybrid to an all-digital operation. CEA agrees with the Commission that the transition to an all-digital service is an appropriate public policy goal, because the spectrum efficiencies and related new service opportunities inherent in such systems can be realized fully only in an all-digital operational mode.[9] For example, the opportunity to introduce new ancillary services in DAB systems, as the Commission observes, is "tied to the initiation of all-digital operations."[10] The Commission seeks comment on whether, with regard to an IBOC system, all-digital compatibility with analog signals should be an evaluative criterion.[11]

CEA believes that IBOC DAB must meet its challenges, and demonstrate a superior radio service, on its own merits in the "hybrid" mode alone. In CEA's view, if hybrid IBOC DAB is not deemed of value by listeners, then its deployment is unlikely, new IBOC receivers will not achieve significant market penetration, and broadcasters will have no incentive to abandon their

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8 *See NPRM* at ¶¶ 8, 17, 24, 28.

9 *See id.* at ¶ 17.

10 *See id.* at ¶ 24.

11 *See id.*

analog operations. Consequently, the opportunity to transition to an all-digital mode would likely never occur. CEA observes that any reliance now, at this early stage in IBOC's consideration, on the future benefits of an all-digital mode deployment and possible service features is tacit admission of the real limitations of a hybrid IBOC DAB service and illustrates the advantages of considering a new-band solution.

IV. CEA LARGELY AGREES WITH THE APPROPRIATENESS OF THE COMMISSION'S PROPOSAL FOR A TENTATIVE SELECTION CRITERIA FOR A DAB SYSTEM.

The Commission seeks to determine which DAB model and/or system would best promote its stated public policy objectives in introducing terrestrial digital radio service. In reaching this fundamental determination, the Commission proposes to apply the following evaluative criteria: (1) enhanced audio fidelity; (2) robustness to interference and other signal impairments; (3) compatibility with existing analog service; (4) spectrum efficiency; (5) flexibility; (6) auxiliary capacity; (7) extensibility; (8) accommodation for existing broadcasters; (9) coverage; and (10) implementation costs/affordability of equipment.[12] The Commission seeks comment on these evaluative criteria in comparing competing DAB systems.

As a general statement, CEA largely agrees with the appropriateness of the proposed selection criteria and offers the National Radio Systems Committee's ("NRSC") test guidelines, which CEA previously submitted in this proceeding, as a means to craft specific standards that should be used to compare competing systems.[13] Additionally, the Commission might also glean additional information from test results contained in CEA's *Final Report* (1997), which is

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12 *See id.* at ¶¶ 20-35.

13 *See* note 3, *supra* (citing *NRSC Test Guidelines*).

already a part of the record in this proceeding, as a benchmark for comparing IBOC and non-IBOC performance.[14]

CEA contends that compatibility with existing analog reception is critical to evaluating IBOC DAB. A technically competent determination of compatibility also relates to (1) test procedures and metrics used to determine analog interference; (2) careful examination of IBOC digital signal spectrum occupancy, bandwidth, and injection level; and (3) the types of analog receivers and circuitry types represented in the testing sample. CEA urges the Commission's technical staff to become fully fluent in these specific areas, as well as their inter-relationships, as this will define whether, and to what degree, analog compatibility is achieved.

For example (in order to assist the Commission's staff and interested parties to better understand these types of evaluations), CEA conducted new laboratory tests to better understand the sensitivity of analog FM stereo receivers to simulated IBOC digital signals which cause an increase in the audio noise when tuned to the "host" analog FM signal. The report that resulted from the laboratory tests is attached as Appendix A to these comments.[15] The results of the tests show the following:

- A 7 dB reduction in digital power of the inserted IBOC signal (from –15 dBc to –22 dBc) improves the average receiver audio signal-to-noise (S/N) performance by almost 7 dB.
- The stereo noise floor increase caused by the IBOC digital signal on the received host FM signal was essentially the same for new and older receiver groups.
- When tuned to the IBOC "host" analog station, the three OEM auto radios' audio S/N is not degraded with the presence of the digital signal at either insertion level.

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14 *See generally Final Report* (cited in note 3, *supra*).

15 *See* Appendix A (Thomas B. Keller, T. Keller Corporation, "FM Receiver Sensitivity to Host IBOC Digital Signal Laboratory Test Results," (Nov. 9, 1999)), *infra*.

- The two after-market auto radios' S/N was reduced with the presence of the digital signal at both signal levels.

Further, CEA notes (*see* Appendix A, Chart #1) that the type of receiver under study has a large effect on the degree of performance degradation introduced by IBOC DAB. For example, as the chart indicates, receiver Numbers 4 and 11 (home Hi-Fi, and shelf combo, respectively) show a marked 22-28 dB degradation in S/N with the presence of IBOC digital energy. This chart also exhibits the relative immunity of some auto receivers (Numbers 1, 5 and 15) mentioned above.

Accordingly, given the foregoing results, CEA believes that any final Commission action in this proceeding that permits IBOC DAB deployment must define with technical specificity the permitted mode of transmission. The –15 dBc insertion level holds more interference potential than does the –22 dBc level, and either implementation offers potentially objectionable degradation to analog reception. CEA urges the Commission, therefore, to weigh these factors carefully in its subsequent decisions.

The Commission suggests that this proceeding may present an opportunity to consider the spectral efficiencies that could be realized by advances in receiver technology over the decades since the analog interference standards were established. The Commission thus seeks comment about "the extent to which state-of-the-art receiver technology may provide additional protection against interference," and information about costs and design considerations that would practically limit interference immunity.[16] CEA suggests that these matters are premature and slightly beyond the scope of the instant proceeding. The fact remains that over 710 million

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16 *NPRM* at ¶ 27.

existing receivers are in use, each with their own interference susceptibility, which must be respected and protected by the Commission in whatever action it takes with respect to DAB. However, a general observation is clear from both the past DAB studies and the recent laboratory investigations about the introduction of low power FM ("LPFM") service proposals: many automobile receivers excel at filtering out adjacent-channel interference, and other types of receivers (including high end component units) are very susceptible to adjacent channel signals, like IBOC.[17]

In the NPRM, the Commission states that it still needs additional information about the specific mix of DAB design attributes that could best meet the current and future needs of all stakeholders.[18] It therefore seeks comment on possible DAB spectrum efficiency standards. CEA finds that the many questions the Commission pose in paragraph 28 highlight the essential nature of DAB system designs that make many technical trade-offs. Most important of these, in CEA's view, is bandwidth versus signal robustness, which has been highlighted by the results contained in the *Final Report*.

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17 *See* Comments of the Consumer Electronics Manufacturers Association and accompanying Exhibit A (Thomas B. Keller & Robert W. McCutcheon, "FM Receiver Interference Tests: Laboratory Test Report," (1999) (These tests were conducted under the auspices of National Public Radio, Consumer Electronics Association, and Corporation for Public Broadcasting.)) in the LPFM Rule Making Proceeding in MM Docket No. 99-25 (filed Aug. 2, 1999).

18 *NPRM* at ¶ 28.

V. ALTHOUGH THE IBOC DAB MODEL PRESENTS MANY ATTRACTIVE ATTRIBUTES, IBOC PROPONENTS HAVE YET TO DEMONSTRATE THAT AN IBOC-DELIVERED AUDIO EXPERIENCE IS ATTRACTIVE TO LISTENERS, SUFFICIENT TO PERSUADE CONSUMERS TO PURCHASE NEW RADIO RECEIVERS.

In the NPRM, the Commission notes that IBOC technology proponents represent, among other things, that IBOC technology would provide superior audio fidelity, signal robustness, and new and improved ancillary services.[19] The Commission also notes that IBOC proponents contend that IBOC technology would be spectrally efficient, in that it would not require a new spectrum allocation. While CEA does not dispute the potential benefits of an IBOC proposal, it urges the Commission to carefully weigh the value of IBOC's relative ease of implementation against any digital and analog performance trade-offs. For one, as the Commission observes, an IBOC approach actually raises spectrum efficiency concerns.[20] The Commission states, for example, that current IBOC system designs are premised on doubling the bandwidth licensed to AM and FM stations to 20 kHz and 400 kHz, respectively, spectrum which is currently included under current "emission masks."[21]

Furthermore, CEA believes that one important attribute that has not been identified in the litany of "attractive" features of an IBOC proposal in the NPRM is whether the IBOC-delivered audio experience is attractive to listeners, over and above that currently provided by analog broadcasting, and to a degree compelling enough to persuade consumers to purchase new radio receivers. The digital revolution in consumer electronics is producing a new cadre of audio

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19 *Id.* at ¶¶ 36-37.

20 *Id.* at ¶ 16.

21 *Id.* at ¶ 38. Further, the *Final Report* (at p. 26) details the resulting digital-to-analog interference results and notes that "the RF emission mask was never intended to apply to intentional insertion of continuous signals, but rather to protect from unintentional spurious and sporadic signals from FM composite modulation."

products competing intensely for listener attention. Absent this element, CEA respectfully disagrees with the Commission's belief "that a workable IBOC system would be superior to a new-spectrum DAB system . . . ."[22] In CEA's view, given the expectations of digital-savvy consumers, no less than a performance level of "CD-quality" sound would prove compelling in the marketplace.

VI. A NEW-SPECTRUM APPROACH HOLDS THE MOST PROMISE TO MEET LISTENER EXPECTATIONS FOR TERRESTRIAL DIGITAL AUDIO RADIO SERVICE WITH HIGH-QUALITY AUDIO, ROBUST COVERAGE, AND AFFORDABILITY.

While IBOC DAB has the advantage of introducing a form of DAB without the need for new spectrum allocation for the digital signal, the Commission must seriously consider the possibility of using new spectrum for terrestrial DAB services. CEA believes that achieving key DAB service performance objectives – *e.g.*, audio quality, interference immunity, robust digital coverage – collectively remain tied to spectrum occupancy; that is, the higher the performance quality desired, the more RF spectrum is needed to provide that service.

In the NPRM, the Commission presents numerous acknowledgements that greater bandwidth supports greater degrees of DAB services and features.[23] The *Final Report*[24] also supports that assumption and presents corroborating data detailing various systems' performance under laboratory and field test conditions. For these reasons, CEA urged the Commission in its comments over the past ten years not to foreclose a variety of options, including spectrum options, until the tests underway were concluded and the relative merits of the varied approaches

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22 *NPRM* at ¶ 37.

23 *Id.* at ¶¶ 40-49.

24 *See generally Final Report.*

to DAB system designs could be evaluated meaningfully. Unfortunately, during this intervening time, spectrum options in the L-band, S-band, and the 746-794 MHz bands that possibly could have been used to deploy terrestrial DAB, instead have been (or about to be) allocated and/or auctioned for other uses.

CEA believes that a new-band approach holds the most promise to meet listener expectations for a service with high-quality audio, robust coverage, and affordability. The degree to which these performance goals can be attained is directly proportional to the amount of spectrum available for deployment. Indeed, CEA's past studies have demonstrated the intricate inter-relationship of the frequency band of use and the ability of system designs to maximize their performance.

In the NPRM, the Commission invites comment on whether the six megahertz of spectrum at 82-88 MHz, currently used for TV Channel 6, could be reallocated to DAB service at the end of the DTV transition.[25] Thus, while CEA supports the Commission's consideration in this proceeding to provide a new band of spectrum for terrestrial DAB, spectrum at the 82-88 MHz band may be inadequate, unless a more modest, stereo-only (2-channel) approach is considered. Additionally, the allocation of only six megahertz of spectrum at 82-88 MHz may provide limited opportunity to deploy a nationwide service that meets listener expectations for at least two reasons.

First, CEA believes that 6 MHz bandwidth (at 82-88 MHz) is inadequate to meet the Commission's public policy objective of ensuring that any DAB system "should, to the maximum extent possible, accommodate all existing broadcasters that desire to initiate DAB

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25 *NPRM* at ¶ 41.

system transmission."[26] Past studies have shown that at least 30 MHz of contiguous spectrum is required to deploy a Eureka-147-based system with channels enough to support a transition of existing analog broadcasters with a DAB outlet.[27] Given this result, CEA believes that two choices remain: (1) either an ample amount of spectrum should be allocated for this service to meet that objective, or (2) the Commission should consider establishing terrestrial DAB as an independent, third audio broadcast service with a fewer number of licensees that compete on their own merits. This second alternative could be structured with deployment in a more modest amount of spectrum, but at the expense of more limited listener appeal, since fewer programming alternatives could be provided in a single market.

Secondly, past CEA studies[28] detailed varied DAB system designs and their resulting performance. Subsequent analyses[29] of these results developed the spectral versus power efficiency of these systems.[30] In those studies, the Eureka-147 DAB was found to be the most power efficient system, but it was also the least bandwidth efficient (at 0.75 bit/s/Hz). In comparison, the in-band/adjacent-channel system (from AT&T) was less power efficient, but at 0.85 bit/s/Hz was found to be more spectrally efficient. In further comparison, the AT&T/Amati

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26 *Id.* at ¶ 32.

27 *See* comments submitted by the National Association of Broadcasters (filed Aug. 20, 1990) in GEN Docket 90-357.

28 *See Final Report.*

29 *See* L. Thibault, G. Soulodre and T. Grusec, "EIA/NRSC DAR Systems Subjective Tests, Part II: Transmission Impairments, IEEE Transactions on Broadcasting," Vol. 43, No. 4, at pp. 353-369 (Dec. 1997).

30 The spectral efficiency represents the number of bits/s of useful information (in this case audio) that can be transmitted per unit of RF signal bandwidth (Hz), while the power efficiency represents the ratio of energy per useful information bit over the noise power spectral density (E_b/N_o) in dB.

(the FM IBOC system that most resembles the current designs of USADR and Lucent) was found to be the most spectrally efficient of the systems at 1.09 bit/s/Hz, but it was less power efficient and it also failed on two of the four mobile test channels. These results illustrate the power and spectral efficiency of DAB systems in the mobile reception environment. The most robust systems tested achieved a spectral efficiency in the range of 0.75-0.85 bit/s/Hz. This finding supports the assertion that a new-band system is more likely to attain the high-performance level required, especially in a mobile reception environment, that will meet listeners' expectations for high-quality, robust and interference-free reception.

CEA provides a report, attached to these comments as Appendix B, titled "Concept Design for a Mobile Multimedia Broadcast Service,"[31] as an illustration of what types of services and performance can be achieved when a new spectrum band is considered.[32] In the report, a "concept design" is developed that shows that a new-band approach can be successfully used to meet the performance objectives of a Mobile Multimedia Broadcast Service ("MMBS") and developed this conclusion after exhaustively evaluating the technical features and demands of the following factors:

- service objectives: multichannel (5.1) sound, scalability, extensive data services, etc.;

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31 *See* Appendix B (Gerald Chouinard, "Concept Design for a Mobile Multimedia Broadcast Service," Sept. 13, 1999), *infra*.

32 This analysis was developed to consider how a new MMBS service might be achieved utilizing UHF TV channels 60-62 & 65-67, the subject of the proceeding in WT Docket No. 99-168. CEA's comments in that proceeding assumed that adequate time remained to develop these findings further, with multi-industry participation, and fully intended to provide the Commission with those findings at that time. However, the requirements of the Balanced Budget Act of 1997 requires the Commission to expedite its auction of these frequencies, which unfortunately prevents developing these issues to full maturity in that proceeding. However, CEA believes the discussion may be valid in this proceeding and incorporates its comments and reply comments in WT Docket No. 99-168 herein, by reference.

- performance objectives: mobile reception, service availability and extent of coverage;
- transmission channel: propagation at 770 MHz, use of on-channel repeaters, antennas, receiver noise and figure of merit;
- multipath considerations: relation to frequency, effect of echoes with various excess delays;
- channel bandwidth versus fading performance;
- MMBS transmission design concept: comparing modulation techniques, coding structure and tradeoffs;
- multiplex structure and options; and
- receiver models and MMBS coverage considerations

One principle finding of this investigation was how many program/data service channels might be offered in seven major cities in the U.S. using certain technical assumptions. These are summarized in the table below:

Main US Cities	MMBS 1.5 MHz frequency blocks per city	Total multichannel audio/data programs per city
New York	6	18
Los Angeles	8	24
San Francisco	9	27
San Diego	5	15
Sacramento	4	12
Denver, CO	9	27
Washington, DC	8	24

Table A. Summary of the expected MMBS capacity in seven major US cities

These findings used conservative allocation assumptions, based on the DTV allocations/ assignments methods, and thus likely understate the eventual services that can be made available. However, these results are also premised on the assumption that the full 36 MHz of spectrum would be allocated. The Concept Design fully develops the intrinsic inter-relation of channel

bandwidth available for MMBS, coding technologies, channel multiplex structure and resulting performance. These technical trade-offs are fully documented there.

CEA presents these findings now, in this proceeding, responding to the Commission's request for comments on whether an "independent DAB transmission system might operate at a higher data rate and thereby support higher audio quality and enhanced ancillary services as compared to an IBOC system operating in hybrid [sic] mode."[33] CEA believes that its MMBS approach conclusively demonstrates that such a higher performing service is achievable, but requires additional spectrum to realize it on a nationwide, ubiquitous level.[34] In addition, recent past experience demonstrates that the combined support of industry and government (including the Executive and Legislative Branches, as well as the FCC) are needed to designate, allocate, and license adequate and appropriately-placed spectrum if an MMBS-type of service is to become a reality.

VII. THE COMMISSION SHOULD ADOPT A SINGLE DAB STANDARD.

CEA believes that it is imperative that the Commission ultimately adopt a single DAB standard. While the Commission tentatively concludes that the public interest compels a Commission role in the development of DAB transmission standards, "with the advice and

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33 *NPRM* at ¶ 42.

34 Further, this concept design assumes COFDM modulation in its development, but this is by no means a final determination but rather used as an illustration of reception capability. Subsequent discussions have suggested that 2VSB modulation would achieve comparable mobile reception robustness, but this needs further study. Also, it should be noted that the 82-88 MHz band proposed in the *NPRM* would likely subject any COFDM-based system to extensive impairments of impulse noise inherent in those frequencies.

involvement of all sectors of the industry,"[35] it also states that it "lack[s] sufficient information" to conclude, at this time, that a Commission-mandated DAB transmission standard is necessary.[36] Accordingly, it solicits further comments on this issue.

The Commission explains that the traditional rationale for mandating a standard arises when two conditions are met: "first, there would be a substantial public benefit from a standard; second, private industry either will not, or cannot, achieve a standard because the private costs of participating in the standard-setting process outweigh the private benefits, or a number of different standards have been developed and private industry cannot reach consensus on a single standard."[37] CEA believes that both of these conditions are met, justifying Commission establishment of a single DAB transmission standard.

CEA observes plainly the substantial public benefit derived from establishing a standard. Technical standardization is critical because the choice of one standard over another can have a major effect on the development of entire industries. Once technological decisions are made, technology develops along a single path. A single standard provides certainty to consumers, licensees, and equipment manufacturers, especially during the launch of this new technology.

Furthermore, a required standard will protect consumers against losses by assuring them that their investments in DAB equipment will not be made obsolete by a different technology. In addition, requiring use of a single standard guarantees compatibility. This assures consumers that the DAB equipment used to listen to one station can be used to listen to every other station. Moreover, a required standard will lead to a more rapid deployment and acceptance of DAB

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35 *Id.* at ¶ 52 (citation omitted).

36 *Id.*

37 *Id.* at ¶ 51.

equipment. Absent a required standard, some consumers and licensees may be reluctant to purchase DAB equipment if they believe that different DAB technologies may become available in the near future. A required standard will reduce such "wait and see" behavior.

With regard to the first of the above-stated conditions for establishing a standard, the Commission surmises: "For example, it may be the case that there is a high degree of compatibility among the several DAB systems. Thus, there may be little public benefit derived from a mandated standard. In addition, developments in digital signal processors ("DSPs") may have obviated the need for a DAB standard or may justify a voluntary or technically narrower approach."[38] CEA notes that it is unclear which "developments in digital signal processors" the Commission suggests "may have obviated the need for a DAB standard." The particular source coding, transmission coding, and modulation schemes used by a DAB system are likely intertwined, but CEA defers on this point to the system proponents for their views. One might assume that receivers would contain sufficient "programmability" such that they could dynamically adapt to numerous transmission formats and coding protocols. However, that capability would not be feasible without a significant cost penalty for receivers and, ultimately, to consumers.

On the second condition, CEA believes that private industry is not likely to reach consensus, necessitating the need for a Commission-mandated standard. A *de facto* approach, as the Commission has suggested,[39] is not likely to succeed with broadcasters, equipment manufacturers, and consumers. Further, where increased spectrum usage is required, the

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38 *Id.* at ¶ 52.

39 *Id.* at ¶ 53.

Commission has the responsibility to ensure that deployment of DAB is consistently conducted without increasing the risk of interference to the public.

VIII. FURTHER LABORATORY AND FIELD TESTS ARE CRITICALLY NEEDED TO ASSESS THE FULL PERFORMANCE POTENTIAL, AND THE INTERFERENCE IMPACT, OF DAB SYSTEMS.

CEA agrees with the Commission's conclusion that "it is necessary and appropriate to rely to some degree on the expertise of the private sector for DAB system evaluations and, ultimately, recommendations for a transmission standard."[40] In this regard, CEA and its members are available and willing to participate in any initiative that stimulates and nurtures adoption of a terrestrial digital radio service that meets listener expectations.

Clearly, the Commission requires a technical basis for subsequent action in this proceeding. Laboratory tests are critically needed to assess the full performance potential, and the interference impact, of DAB systems. Field tests are also required to corroborate laboratory results and to discover other unanticipated events. CEA agrees with Lucent that a common testing platform, procedures, equipment and personnel are required to derive meaningful system comparisons.[41] This is precisely why CEA undertook its initiative to accomplish its previous investigations.

CEA is heartened that the National Radio System Committee's ("NRSC") DAB Subcommittee also recently agreed to prepare for a second phase of testing the IBOC systems under its purview, with a common testing regimen. However, the Commission must indicate its willingness to support such a testing initiative, and to rely on the data so derived, before CEA

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40 *Id.* at ¶ 58.

41 *Id.* at ¶ 56 (the Commission noting Lucent's proposals).

can commit its resources to such an exercise. CEA fully understands and agrees with the Commission's conclusion that, at this time, it is premature to commit to any particular approach.[42] These matters should become clearer within the next few months, and CEA urges the Commission's commitment to a testing process at that time, as appropriate. CEA believes that the NRSC DAB Subcommittee is the appropriate venue to oversee and conduct comprehensive, objective, impartial testing of IBOC DAB systems. CEA welcomes the Commission's plan to monitor this process closely. Further, as stated above, CEA also believes that the proposed new spectrum band approach has considerably more potential than IBOC to craft a successful DAB service. Therefore, should the Commission proceed further on this initiative, and consider an appropriate new spectrum allocation for deployment of terrestrial digital radio service, then CEA believes that the Advisory Committee approach holds merit and should be created.[43]

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42 *See id.* at ¶ 57.

43 This assumes that the broadcast industry and its organizations would continue to resist any non-IBOC DAR solution. That position has complicated past interests to compare IBOC and non-IBOC system performance from data derived under common testing regimens.

IX. CONCLUSION

For the reasons stated herein, CEA urges the Commission to introduce the establishment of terrestrial digital radio consistent with the views expressed by CEA herein. The DAB system ultimately selected should be able to meet consumer expectations in terms of sound quality, and should be a system that does not interfere with existing analog radio services or other digital services.

Respectfully submitted,

CONSUMER ELECTRONICS ASSOCIATION

By: Michael Petricone /BEB

Michael Petricone
Vice President,
Technology Policy

Gary S. Klein
Vice President,
Government and Legal Affairs

Ralph Justus
Vice President,
Technology and Standards

2500 Wilson Boulevard
Arlington, Virginia 22201
(703) 907-7600

Of Counsel:
David A. Nall
Benigno E. Bartolome
Squire, Sanders & Dempsey L.L.P.
1201 Pennsylvania Avenue, N.W.
Post Office Box 407
Washington, D.C. 20044
(202) 626-6600

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